

# E787 gamma analysis

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- Introduction
  - E787-98 3gamma trigger, dataset
  - previous results (E787-95, KEK E470)
- $K^+ \rightarrow \mu^+ \pi^0 \nu \gamma$ : T. Fujiwara (Kyoto Univ.)
- $K^+ \rightarrow \pi^+ \pi^0 \gamma$ : T. Tsunemi (Univ. Tokyo)

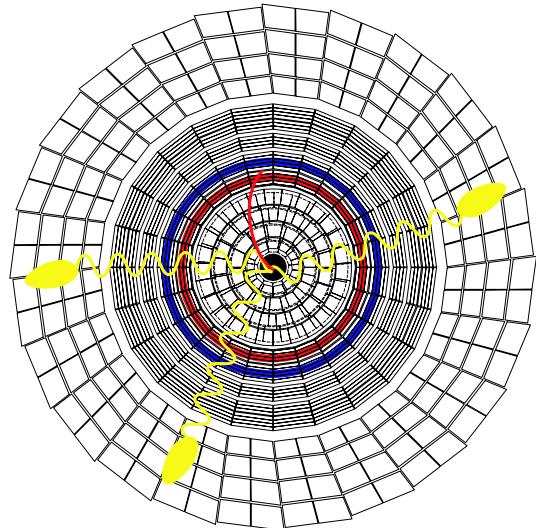
## Byproducts @ upgraded-E787

'94	km2g	$K^+ \rightarrow \mu^+ \nu \gamma_{SD}$	PRL'00
		... 3-day dedicated run	
'95	3 $\gamma$ -95	$K^+ \rightarrow \pi^+ \pi^0 \gamma_{DE}$	PRL'00
		... prescaled, 5ev/spill in SMX	
	kp22	$K^+ \rightarrow \pi^+ \pi^0 \nu \bar{\nu}$	PR-D'01
		... prescaled, 1ev/spill in SMX	
'96-97	1 $\gamma$	$K^+ \rightarrow \pi^+ \gamma$	PR-D'02
		... prescaled, 1ev/spill in SMX	

'98 3 $\gamma$ -98     $K^+ \rightarrow \mu^+ \pi^0 \nu \gamma$ : first observation  
                      $K^+ \rightarrow \pi^+ \pi^0 \gamma_{DE}$ : further measurement  
                     ... prescaled, 10ev/spill in SMX

# **3 $\gamma$ -98 trigger compared to 3 $\gamma$ -95 (1)**

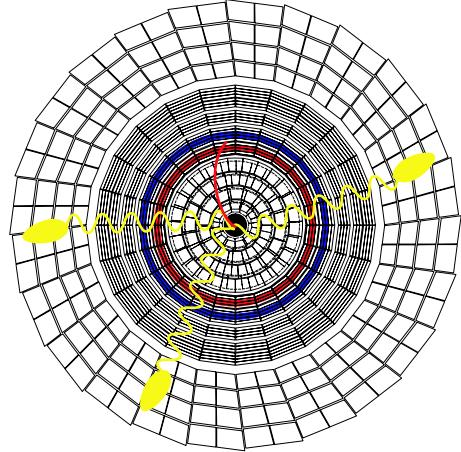
- stopped kaon decay (minbias):  $K_B \cdot DC \cdot T \bullet 2$
- Charged Track with short range:



- RS layer 3, 4, 5, 6:  
$$\frac{(3_{ct} + 4_{ct})}{(9 + \dots + 21)} \cdot \frac{1}{(7_{CT} + 8_{CT})}$$
- RS layer 6, 7, 8, 9, 10:  
$$\frac{(6_{ct} + 7_{ct})}{(19_{CT} + 20_{CT} + 21_{CT})} \cdot \frac{1}{(11 + \dots + 20)}$$

## **3 $\gamma$ -98 trigger compared to 3 $\gamma$ -95 (2)**

- stopped kaon decay (minbias):  $K_B \cdot DC \cdot T \bullet 2$
- Charged Track with short range: **RS layer 3, 4, 5, 6**
- Photons:



- $\geq 3 \gamma$  clusters in BV  
( $\pi^0 \rightarrow \gamma\gamma$  and  $\gamma_3$ ): NG3
- no  $\gamma$  in EC, RS:  $\overline{EC} \cdot \overline{HEX}$

## **3 $\gamma$ -98 dataset compared to 3 $\gamma$ -95**

\* in SMX from run 38347(Sep-17) to the end(Dec-31)

	3 $\gamma$ -98	3 $\gamma$ -95
prescale $N_{KB_L}/\text{ps}$	5 $3.57 \times 10^{11}$ ( $\times 1.3$ )	5 $2.83 \times 10^{11}$
# of trigger	$9.4 \times 10^6$ ( $\times 0.85$ )	$11. \times 10^6$

## $K^+ \rightarrow \mu^+ \pi^0 \nu \gamma$ (**Km3g, radiative $K_{\mu 3}$** )

- Bubble-Chamber exp @Argonne  
 $< 6.1 \times 10^{-5}$  (90% C.L.), PR-D8 (1973) 1307
- SM-ChPT prediction:  $2 \times 10^{-5}$
- E787-98's first observation with  $\gg 10$  signal events.

## $K^+ \rightarrow \pi^+ \pi^0 \gamma_{DE}$ (**Kp2g, radiative $K_{\pi 2}$** )

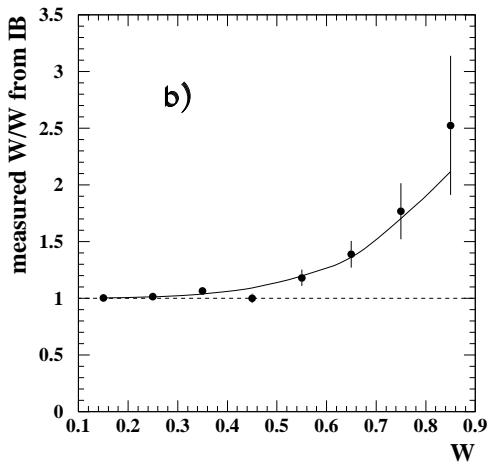
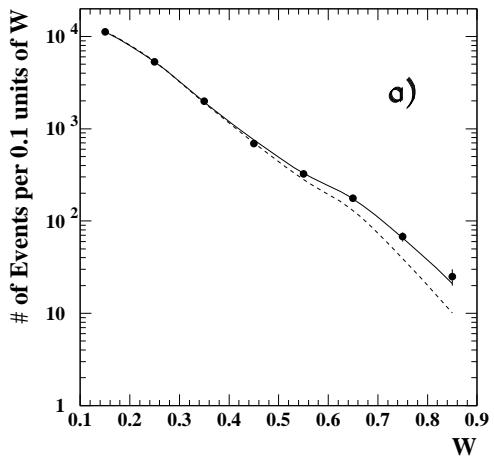
$55 < T_{\pi^+} < 90$  MeV (above  $K_{\pi;3}$ ),  
decay spectrum  $\Rightarrow$  Direct Emission component

- old experiments,  $K^+$  decay-in-flight  
 $(1.8 \pm 0.4) \times 10^{-5}$ , PDG-98
- E787-95, 20K events in  $140 < P_{\pi^+} < 180$  MeV/c  
 $(4.7 \pm 0.8 \pm 0.3) \times 10^{-6}$ , PRL 85 (2000) 4856
- KEK-E470, 4K events in  $P_{\pi^+} < 175$  MeV/c  
 $(3.2 \pm 1.3 \pm 1.0) \times 10^{-6}$ , PL B554 (2003) 7

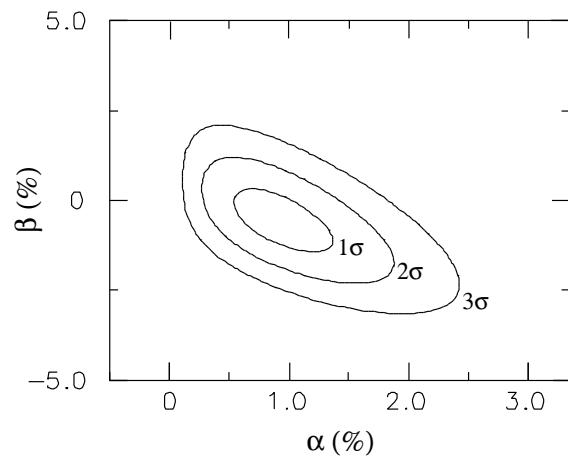
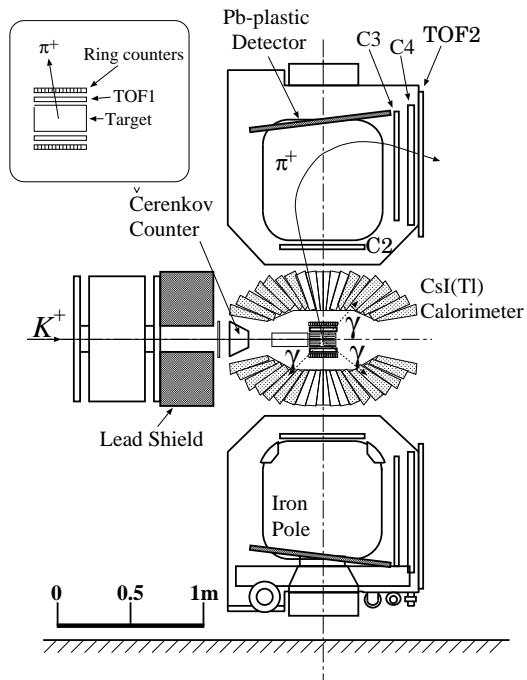
# $K^+ \rightarrow \pi^+ \pi^0 \gamma_{DE}$ in E787: W-spectrum

$$W^2 \equiv (p \cdot q)(p_+ \cdot q) / (m_{\pi^+}^2 \times m_K^2)$$

( $p$ ,  $p_+$ , and  $q$ : 4-momenta of the  $K^+$ ,  $\pi^+$  and  $\gamma$ )



# KEK-E470 (E246 for T-violation in $K_{\mu 3}$ )



# $K^+ \rightarrow \pi^+ \pi^0 \gamma_{DE}$ in E470: three variables

$\cos \theta_{\pi^+ \gamma_3}, \cos \theta_{\pi^0 \gamma_3}, E_{\gamma_3}$

